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XIV.—*Hicksonella, a New Gorgonellid Genus.*

By James J. Simpson, M.A., B.Sc.
(Carnegie Fellow, University of Aberdeen.)

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Plate XIII.

In my recently published "Revision of the Juncellid-group of the Gorgonellidæ,"* I did not include any notice of the unique form described by Professor S. J. Hickson under the name of *Juncella spiralis*. Its puzzling and divergent character made a separate discussion advisable.†

In the Revision the Juncellids were divided into three genera, namely, *Juncella*, *Scirpearia*, and *Nicella*, and an examination of the diagnoses given there, along with the following descriptions,

* Proc. Roy. Irish Acad., No. 7 (1910) pp. 247–386 (19 pls.).

† I wish to take this opportunity of thanking Professor J. Arthur Thomson for entrusting these forms to me for identification and description, and also the Carnegie Trust for a grant to cover the cost of the illustrations.

EXPLANATION OF PLATE XIII.

Fig. 1.—Portion of *Hicksonella spiralis*, enlarged to show the spiral form and also the distribution and nature of the verrucæ. × 3.
,, 2.—Spicules from the verrucæ of ditto: (*a*) near base, (*b*) near tip.
,, 3.—Spicules from the cœnenchyma of ditto: (*a*) near base, (*b*) near tip.
,, 4.—Two views of the same portion of *H. flagellata* sp. n.: (*a*) polyp-bearing, (*b*) non-polyp-bearing aspect. × 4.
,, 5.—Spicules of ditto.
,, 6.—Two views of the same portion enlarged of *H. capensis* sp. n.: (*a*) polyp-bearing, (*b*) non-polyp-bearing aspect. × 4.
,, 7.—Spicules of *H. capensis* sp. n.

will show the impossibility of linking the specimens now under consideration to any of these genera. It will be shown that it is necessary to establish a new genus.

As a full description of the *Juncella spiralis* type has been given by Hickson,* we may briefly consider some of the most characteristic features before proceeding to any taxonomic consideration. The colonies were all unbranched; one of them was 220 mm. in length without the base, which had been broken off. The axis was pale brown in colour, and had rings of lime embedded in the horny matrix. The verrucæ were all prominent and arranged irregularly on two-thirds of the circumference of the stem, leaving a bare track on one side free from verrucæ from end to end of the colony. The bare track and verrucæ were covered with a dense armature of spicules, and "it is difficult to believe that the verrucæ can ever be retracted." The spicules consisted chiefly of irregularly tuberculated plates and spindles. "The spicules are tightly jammed together to form an impenetrable armour. The surface of the verrucæ has a distinctly squamate appearance, the plate-like spicules slightly over-lapping."

Hicksonella † *spiralis* g.n. (= *Juncella spiralis* Hickson).
Plate XIII. figs. 1–3.

Two specimens referable to this species occur in a collection from Cape Colony. Professor Hickson very kindly sent me a small portion of his type specimen for examination, and one of the present colonies agrees with it in almost every feature. It is 40 cm. in length, the diameter is 3·5 mm. near the base, and about 2 mm. at the tip. The tapering is thus very gradual, in fact at a distance of 7 cm. from the tip there is very little difference in the diameter from that at the base.

Another specimen is 20 cm. in length, and has a maximum diameter of 2·5 mm. at the base. In both specimens the basal part is wanting.

The axis is densely calcareous, and very hard in the lower portion, so that, except near the apex, the colony is very rigid. It is composed of concentric laminæ of the typical Gorgonellid type. There is a distinct, central, more densely calcareous portion, and the surface is marked by a series of minute longitudinal furrows. The diameter near the present base is 1·5 mm., but this diminishes gradually to a hair-like fineness at the tip.

* The Alcyonaria of the Cape of Good Hope. Part III., Marine Investigations in South Africa, iii. (1904) pp. 231–33 (4 figs.).

† I wish to associate with this new and remarkable genus the name of Professor Sydney J. Hickson, D.Sc. F.R.S., who has done so much to elucidate the structure and relationship of Alcyonarians, and to whom we are indebted for the original observations on *Hicksonella*.

The cœnenchyma is very thin and densely spiculose; when dry it is extremely brittle.

The canal system is difficult to determine owing to the thinness of the cœnenchyma. It was found impossible to detach a portion of the cœnenchyma from the axis without damaging the canals. Serial sections were made from a decalcified portion of the cœnenchyma, but the results were not very satisfactory. The furrows on the axis suggest a concentric series of canals separating the cœnenchyma from the axis, but it is very doubtful whether one or more of these is larger than the others, and the possession of an outer series of canals is quite uncertain.

From end to end of the colony there is a narrow streak devoid of polyps, which participates in the spiral arrangement of the colony (pl. XIII. fig. 1). It occupies between one-fourth and one-third of the circumference of the cœnenchyma. The remaining three-fourths to two-thirds is densely covered with small elongated verrucæ. In the smaller specimen the basal portion, for a distance of 8 cm., is devoid of polyps.

The verrucæ are long and club-shaped, and somewhat resemble those of *Scirpearia flagellum*; the terminal part is considerably enlarged. They are about 1·5 mm. in length, and about 0·5 mm. in diameter at the widest part. They are very spiculose, and the surface, when viewed with a lens, reveals a series of minute horizontal, overlapping scales, which recalls the armature of a Caligorgid.

At the utmost they are only feebly retractile into the cœnenchyma, but their enormous size, the thinness of the cœnenchyma and their dense armature, would seem to preclude the possibility of any great degree of retraction.

When the tentacles are inturned there is a distinct eight-rayed figure at the summit of the verrucæ, and the scales on the aboral surface of the tentacles form a sort of pseudo-operculum. Further retraction of the tentacles results in a very definite horizontal wrinkling of the verrucæ.

The verrucæ are very densely packed on the polyp-bearing region, and about a dozen occur on one transverse line.

Young polyps occur scattered among the older ones, and so render any definite arrangement impossible.

In the larger specimen the colour of the cœnenchyma in the bare tract is a dark brick-red, but the verrucæ are creamy white with an occasional trace of an orange tint. In the smaller specimen the bare tract is also reddish-orange, but the polyps are pinkish-purple.

The spicules of this species are extremely characteristic, but very diverse in form and irregular in outline.

The figs. 2 *a*, *b* and 3 *a*, *b*, show some of the more definite types.

Fig. 2 shows those of (*a*) the verrucæ near the base, (*b*) the verrucæ near the tip.

Fig. 3 shows those of (*a*) the cœnenchyma near the base, (*b*) the cœnenchyma near the tip.

The following is a list of the chief types with their measurements (length by breadth in millimetres):

I. Cœnenchyma:
   1. Spindles, very thick with close-set warts. (0·046 × 0·019; 0·046 × 0·015; 0·042 × 0·019.)
   2. Short, stumpy spindles, densely warted. (0·027 × 0·019; 0·027 × 0·015; 0·023 × 0·015.)
   3. Almost spherical warty forms. (0·019 × 0·019; 0·015 × 0·015; 0·012 × 0·012.)

II. Polyps:
   1. Long thick spindles, with fewer and longer warts than in (*a*) of the cœnenchyma. (0·053 × 0·012; 0·046 × 0·015.)
   2. Spindles with very few long warts. (0·042 × 0·011; 0·038 × 0·015.)
   3. Spindles, still shorter, and with fewer warts. (0·031 × 0·015; 0·027 × 0·012.)
   4. Flat, irregular scales from the verrucæ. (0·034 × 0·015; 0·031 × 0·011.)
   5. Crosses. (0·038 × 0·019; 0·031 × 0·031.)

Locality:—Cape Morgan, N.N.E. 9¾ miles; depth, 47 fathoms; bottom, broken shells (25. vii. 01). Previously recorded from Cape Morgan, 32° 45′ 45″ S., 28° 26′ 15″ E.; 36 fathoms; stones (12. i. 01).

Hicksonella flagellata sp. n. Plate XIII. figs. 4, 5.

To this new species we refer two small complete specimens and a portion of a much larger specimen from the Cape. The longer complete colony is 20 cm. in length and the shorter is 12 cm., while the length of the broken portion is also 20 cm. The first specimen has a maximum breadth of 2 mm.; the second is about the same size; the fragment is 3 mm. in breadth.

The cœnenchyma is extremely thin in all the specimens, and in the non-polyp-bearing part the dark axis is easily seen through it. It is densely spiculose and extremely brittle, especially when dry. The surface is very arenaceous in appearance.

The axis is comparatively soft; it is composed of concentric laminæ, which consist of a horny substance in which calcareous matter is deposited.

From end to end of the colony there runs a streak devoid of polyps and occupying about one-third of the circumference of the stem. The polyps occur densely packed on the remainder of the circumference; these project laterally and so add to the breadth of

the colony. Towards the base the polyps diminish in number while on the basal 4 or 5 cm. they are altogether absent. No definite arrangement is discernible, and young polyps occur scattered amongst the older forms.

The verrucæ are elongated and club-shaped (pl. XIII. fig. 4*a*); they are about 1·5 mm. in length and about 0·5 mm. in diameter near the apex. They are not retractile into the cœnenchyma, and the swollen terminal part is due to the withdrawal of the anthocodia within the verruca. They are densely spiculose, and the scales on the aboral surface of the tentacles form a pseudo-operculum to the partially retracted anthocodia. Fig. 4*b* shows the characteristic appearance of the portion figured in 4*a* from the non-polyp-bearing aspect.

The spicules (pl. XIII. fig. 5) of this species are very characteristic. The following are some of the chief types, with measurements, length by breadth, in millimetres:—

1. Thick, massive, warty spindles. (0·053 × 0·015; 0·049 × 0·011; 0·038 × 0·015; 0·038 × 0·011.)
2. Smaller; usually curved spindles with the warts more developed on the convex side. (0·046 × 0·008; 0·031 × 0·008.)
3. Irregular scales (from the verrucæ). (0·031 × 0·011; 0·027 × 0·015.)
4. Aberrant type, resembling crosses. (0·034 × 0·023.)
5. Peculiar, bilaterally symmetrical type with a sort of thick foliaceous expansion. (0·015 × 0·015; 0·015 × 0·011; 0·011 × 0·011.)
6. Birotate forms (like those in *Suberogorgia verriculata*). (0·011 × 0·008; 0·008 × 0·008.)

Locality:—Cape Morgan, N. ½ W., 10½ miles; depth, 77 fathoms. By dredge. Rocks and broken shells (26. vii. 1901).

Hicksonella capensis sp.n. Plate XIII. figs. 6, 7.

This species has been established to include a very characteristic colony 75 cm. in length without the basal portion. The diameter at the present base is 3·5 mm.; midway it is 3·25 mm., while near the tip it is 3 mm., so that the tapering is very slight. The actual tip is conical.

The colony is twisted in an irregular open spiral throughout its entire length, but in such a way that the bare tract is always to the inside.

The cœnenchyma is extremely thin and is densely spiculose. The axis is composed of concentric laminæ, which consist of a horny substance impregnated with some form of calcareous matter. It is very hard, white in colour, and the surface is marked by deep longitudinal furrows. It tapers to a hair-like fineness at the tip.

The polyps are disposed over about three-fourths of the surface of the colony, leaving a bare longitudinal track which is very marked in the lower part, but almost disappears in the upper portion. The verrucæ are small, elongated and slightly club-shaped; they are about 2·5 mm. long and 0·25 mm. in diameter, and are much more openly disposed than in the other species (pl. XIII. fig. 6*a*). Fig. 6*b* shows the appearance from the non-polyp-bearing aspect. The tentacles are first infolded and then withdrawn into the upper part of the verrucæ, but the verrucæ themselves are not retractile into the cœnenchyma. The colour of the cœnenchyma is orange-red, but the verrucæ are almost white.

The spicules of this species are extremely irregular in form, but the following types may be distinguished (pl. XIII. fig. 7):—

1. Short slightly warty spindles. (0·07 × 0·015.)
2. Spindles longer and more warty. (0·09 × 0·038; 0·08 × 0·038.)
3. Spindles still longer and more warty. (0·13 × 0·05; 0·14 × 0·046; 0·16 × 0·065; 0·2 × 0·06.)
4. Very irregular forms (probably developed from [3]). (0·17 × 0·11; 0·16 × 0·13.)
5. Flat, irregular scales. (0·14 × 0·09.)
6. Thick, warty, almost spherical forms. (0·06 × 0·045; 0·053 × 0·034.)
7. Crosses (aberrant). (0·12 × 0·11.)

Locality:—Red Cliff, S. of Morewood Cave, N.W. ¾ N. 6½ miles. Natal. Depth, 37 fathoms; bottom, sand and shells.

Position of Hicksonella.

In this connexion the axis stands first to be considered. As will be seen from the descriptions of the various species, it is composed of concentric laminæ; these laminæ consist of a horny substance containing some form of calcareous deposit. It has been impossible so far to determine the nature of this limy deposit, but it is hoped that some solvent may be found to decompose the organic matter, and so enable a microscopic examination of the inorganic residue to be made. Until this is done, however, determination based on axial structure is impossible. We have, however, in our Revision of the Juncellids, discussed the possible affinities of several other specimens whose axis is similar to the one under consideration, and the resemblance strongly suggests that the present specimens approach closely to the Gorgonellidæ, to which family we would therefore temporarily assign them.

In the work cited above, after an exhaustive examination of a very large number of Juncellids, we suggested an emended classification, and included in the genus *Juncella* only those species whose spicules contained the type known as "clubs." This type of spicule

was first described and figured by Kölliker in his Icones Histiologicæ, p. 140, taf. xviii. fig. 46. In the Revision of the Juncellid-group of the Gorgonellidæ several figures of this type of spicules are given (fig. 4, *a–g*).

The general form approaches that of the well-known "Indian club;" there is a distinct smooth median part or handle, which is surmounted by a few spines. The club-part also bears spines, and the most important characteristic is the fact that these species are all directed away from the shaft, and do not arise perpendicularly.

Some doubt seems to have arisen since the time of Kölliker as to the exact nature of the "club," and this dubiety accounts for the original inclusion of the species *spiralis* in the genus *Juncella*. Hickson (op. cit.) describes a form of spicules as a club (pl. viii. fig. 8), but it is a club essentially different from Kölliker's type.

The spiculation as a whole is quite unlike that of any species of *Juncella* (op. cit., figs. 14, 23, and 26), so that it is impossible to refer the present specimens to that genus. They are even further removed from *Scirpearia* and *Nicella*, so that it seems necessary to form a new genus to include them.

Diagnosis of Hicksonella g. n.

Colony simple, flagelliform, and generally twisted in a more or less open spiral at least in the older colonies. The axis consists of concentric laminæ which are composed of a horny substance impregnated with some form of calcareous matter. It is generally hard, and the surface is marked by longitudinal ridges and furrows.

The cœnenchyma is extremely thin and densely spiculose; it is very brittle, especially when dry. The polyps are disposed in a broad longitudinal band; this leaves a narrow bare strip which traverses the whole length of the colony. The verrucæ are not retractile into the cœnenchyma, and are elongated, slender and slightly club-shaped in the upper portion; they are covered with minute spicules, which appear like overlapping scales; the spicules on the aboral surface of the tentacles form a sort of pseudo-operculum to the partially retracted anthocodia.

The spicules vary in the different species, but the following are the chief types:—(1) Irregularly warted spindles; (2) flat, smooth, or slightly warty scales; (3) large irregular forms; (4) crosses; and (5) bi-rotate forms.

Specific Diagnoses.

Hicksonella spiralis (Hickson) = *Juncella spiralis* Hickson.

Colony unbranched; in the larger forms spirally twisted. The cœnenchyma is thin and densely packed with scale-like spicules; the axis is composed of concentric laminæ of a horny substance,

in which a calcareous deposit is embedded. The polyps are restricted to a region occupying two-thirds to three-fourths of the circumference of the cœnenchyma; a longitudinal bare tract occupies the remaining part. The verrucæ are long and club-shaped, and are evidently not retractile into the cœnenchyma; they are closely packed together, and are covered with minute overlapping, scale-like spicules. The flat thin scales on the aboral surface of the tentacles forms a sort of pseudo-operculum to the partially retracted polyp.

The chief types of spicules are (1) in the cœnenchyma very thick spindles with close-set irregular warts, passing by gradual transitions to almost spherical warty forms; (2) in the polyps (*a*) long thick spindles with few long warts; (*b*) irregular forms and crosses; (*c*) small flat thin scales.

Hicksonella flagellata sp. n.

Elongated filiform colonies which, at any rate in the younger specimens, have only a trace of a very open spiral structure. The cœnenchyma is extremely thin and densely spiculose. The axis is horny and calcareous, and is composed of concentric laminæ. The polyps are confined to a broad longitudinal band occupying about two-thirds of the circumference. The verrucæ are elongated and club-shaped, and are not retractile into the cœnenchyma. The spicules are exceedingly minute, and very characteristic. They consist for the most part of (1) thick massive, warty spindles; (2) peculiar, bilaterally symmetrical forms, with a sort of thick foliaceous expansion; (3) bi-rotate forms (like those in the *Suberogorgia verriculata*); and (4) scales.

Hicksonella capensis sp. n.

Colony elongate, simple, and irregularly twisted in a spiral manner. The cœnenchyma is thin, and very spiculose. The axis is composed of concentric horny and calcareous laminæ. The polyps are disposed in a broad longitudinal band; they are very long, slender, and slightly club-shaped; they are covered with small spicules transversely arranged, and are not retractile into the cœnenchyma. The spicules consist of (*a*) short, slightly warty spindles; (*b*) longer, and more warty spindles; (*c*) irregular forms; (*d*) flat, irregular scales; and (*e*) crosses.

Distribution.—(1) Geographical. All three species were found off the east coast of South Africa, and therefore their inclusion in the Family Gorgonellidæ does not extend the distribution of that family.

H. spiralis. Off Cape Morgan.
H. flagellata. Off Cape Morgan.
H. capensis. Red Cliff, south of Morewood Cave, Natal.

(2) Bathymetrical. This genus, like other Gorgonellids, is represented by shallow-water forms; *H. spiralis* was dredged in 36 and 47 fathoms, and *H. capensis* in 37 fathoms.

Note on the Genus.

Before leaving *Hicksonella*, however, it may be of interest to consider some of the more characteristic features, for example: (1) the distribution of the verrucæ, and (2) the spiral form. Professor Hickson (ii. p. 232), has drawn attention to these, and has put forward several suggestions as to their possible origin, so that, before taking each in detail, we shall quote his observations in full, and so obviate any possibility of misinterpretation which might result from detached references.

"This bare track, i.e. the part devoid of polyps, is seen in some other species of *Juncella*. In the description of *J. juncea*, from the Isle of Bourbon, Milne-Edwards and Haime state that the calices leave some trace of a median cœnenchymatous space. Ridley also states that there is a distinct groove in the specimen of *J. juncea* obtained by the 'Alert.'

The squamate armature of the verrucæ shows some affinities with the characters of the Primnoidæ, but, as the plate-like spicules are so small and there are no definite opercular plates, its affinities with *Juncella* are closer. It is noteworthy, however, that in the Primnoine genus *Calypterinus* the calices do not occur on one side of the stock. The track which is free from the calices in *Calypterinus*, however, is covered by the overlapping scales of the lateral calices so as to form a tube. These bare tracks on one side of the stock in *Juncella spiralis* and *Calypterinus allmani* have a certain resemblance to the bare tracks on one side of the smaller branches of some forms of *Solenocaulon*, and suggest the presence of symbiotic Crustacea. There is no evidence in support of this at present, but it would be worth the trouble of any naturalist, who has the opportunity of dredging in these waters, to note the character of any Alpheidæ or other animals that might possibly live with this *Juncella*. Dr. Gilchrist's note that nothing was found around which the stock twisted, is of the nature of a support for the suggestion that the spiral form of the larger stocks is associated with the presence of some epizoic animal. We may, for the present, regard the spiral form and the bare track as characters of the species, but if they prove to be mere adaptations to an epizoic animal their importance must be considerably discounted."

The question of the nature of the bare tract is of more than passing importance, for if, as Professor Hickson suggests, it is due to some epizoic animal, it must be discounted in any question of a taxonomic nature. A study of the species which he has named along with some others of a similar character, may, however, help

to suggest another possible explanation. For this purpose let us consider the following species:—

1. *Juncella juncea.*
2. *Scirpearia flagellum.*
3. *Suberogorgia köllikeri.*
4. *Lophogorgia lutkeni.*
5. *Juncella trilineata.*
6. *Scirpearia quadrilineata.*
7. *Calypterinus allmani.*

Juncella juncea and *Scirpearia flagellum*, in common with all other Juncellids, except *Juncella trilineata* and *Scirpearia quadrilineata*, have the polyps disposed in two longitudinal series separated by two diametrically opposite longitudinal bare tracts.

In *Suberogorgia köllikeri* the polyps arise from all parts of the stem and branches, with the exception of a narrow, often wavy, portion on either side of the cylindrical axis.

In *Lophogorgia lutkeni* the polyps are numerous and occur on both sides of the stem and branches; the central portion of both the main stem and branches on both surfaces are destitute of polyps.

Again, the stem and branches are flattened in the plane of branching and are marked on the flat sides by a narrow winding groove or furrow, which is continued along the flattened surfaces of the secondary branches. The polyp-bearing surface is divided into two lateral bands by means of the two grooves.

In *Juncella trilineata* polyps arise in three different bands, leaving three narrow bare strips, each of which has in its centre a slight rib or keel.

In *Scirpearia quadrilineata* the polyps are grouped in four definite longitudinal series separated by four bare spaces.

In *Calypterinus allmani* there is a bare tract on one side of the colony, otherwise the polyps occur all round.

In *Hicksonella* the verrucæ are all prominent, and arranged irregularly on two-thirds of the circumference of the stock, leaving a bare tract on one side free from verrucæ for the whole length of the stock.

A detailed discussion of the question under consideration with regard to the various species of Juncellids has been given in the "Revision of the Gorgonellids," so that it is only necessary here to recapitulate the conclusions which have been there stated.

1. In all species of Juncellids, so far known, the polyps are disposed in a certain number—two, three or four longitudinal series which are separated by a similar number of bare tracts. This number is constant for the species.

2. There is always a definite number of nutrient canals larger than the others, which are known as the main longitudinal canals.

3. These main canals always correspond in number and position to the bare tracts.

In *Suberogorgia köllikeri*, also, the longitudinal bare strips denote the position of the two longitudinal canals much larger than the others. The same holds true in the case of *Lophogorgia lutkeni*.

In all the species so far described the cœnenchyma is moderately thick, and it has been possible to verify these points by means of transverse sections, but unfortunately the extreme thinness and the densely spiculose nature of the cœnenchyma in *Calypterinus allmani* and *Hicksonella* have rendered it impossible to determine, so far, whether any main longitudinal nutrient canals exist. Is it not possible, however, that in these species, as in the others cited, the occurrence of a bare tract throughout the entire length of the colony may be an outward manifestation of internal morphological structure, and that it corresponds to the position of a single main longitudinal nutrient canal?

If this be so, there exists in Juncellids a complete series from one to four main canals, thus:

1. *Hicksonella* sp. . .	One main canal.
2. *Juncella juncea*, etc. .	Two main canals.
3. *Juncella trilineata* .	Three main canals.
4. *Scirpearia quadrilineata* .	Four main canals.

Other features, however, seem to point to the unilateral symmetry being of morphological and not of mechanical origin. And in this connexion the spiral nature of the colonies must be considered. It will be seen from the descriptions of the three species given in this paper that two of these are spirally twisted, and also that the spiral arrangement does not commence at the very base, but at a considerable distance from it. In the third species the colonies are all small, and it is possible that they, later on, might have developed the spiral form.

An analogous case is seen in several Antipatharia in which the polyps have morphologically a unilateral disposition. In the waters around the Mergui Archipelago and also on the reefs on the East Coast of Africa, we have had occasion to examine a large number of spirally twisted colonies, and in no case was any form of support found. Now in the majority of these cases and also in the larger colony of *Hicksonella spiralis* examined, if any rigid support existed it must also have been spirally twisted, as will be evident from fig. 1, so that it is extremely improbable that these specimens could have been detached from such a support before being brought to the surface of the water. Even if that were possible and had actually happened, it would, of necessity, have caused considerable damage to the colony. No such evidence of fracture is to be seen on any specimen.

On the other hand it is difficult to imagine how the spiral effect could be produced by free living animals, such as Crustaceans,

when we take into consideration the enormous differences in the sizes of the spirals as seen in *Hicksonella spiralis* and *Hicksonella capensis*.

If then, the morphological origin of the unilateral disposition of the polyps be admitted as possible, an explanation of the spiral form assumed by such simple Alcyonaria and Antipatharia may exist on this basis. In colonial Cœlenterates the rate of growth in the region of the polyps is always far in excess of that in the non-polyp-bearing cœnenchymatous portion. This, in part, accounts for the flabellate colonies so often met with in Alcyonaria, but completely explains the flattening of branches of species with bilaterally disposed polyps. On the other hand, in large bushy Alcyonaria and Antipatharia it is always found that the polyps are directed outwards, so that the unilateral growth finds expression in all directions. In other words, the effect of the unilateral growth in one series of branches is neutralized by that in other series of branches growing in opposite directions.

Let us now consider the case of simple colonies.

1. In those whose polyps are disposed in four series, the growth is in four directions in two planes at right angles to one another, e.g. *Scirpearia quadrilineata*, and these consequently neutralize one another.

2. In *Juncella trilineata* the growth is in three directions, each of which encloses equal angles with the other. These also neutralize one another.

3. In other Juncellids the polyps arise in one plane, and are therefore situated diametrically opposite, and the colony is there still symmetrical.

4. If, however, the polyps all arise on one side, the growth is greater in that direction than in the other, and as the support in all these cases is originally central, this will naturally result in an overbalancing of the colony.

Is it not possible that, in maintaining symmetry in the colony, and also in endeavouring to expose the polyps equally to the food supply (a feature seen in all colonial organisms), this excessive growth might find expression in a spiral form (see pl. XIII. fig. 1)?

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